Annexure – II (Question Paper Template)

Instructions: Candidates should read carefully the instructions printed on the question paper and on the cover page of the Answer Book, which is provided for their use.

(1) This question paper contains two pages.
(2) All Questions are Compulsory.
(3) All questions carry equal marks.
(4) Answer to each new question is to be started on a fresh page.
(5) Figures in the brackets on the right indicate full marks.
(6) Assume suitable data wherever required, but justify it.
(7) Draw the neat labelled diagrams, wherever necessary.

Question No.		Max. Marks
Q1 (a)	i. State the sampling theorem ii. Consider the analog signal, $x_a(t) = \sin 480\pi t + 3 \sin 720\pi t$ Determine the minimum sampling frequency and the sampled version of the analog signal at this frequency. **OR** i. Find the period of the given signal if it is periodic $x(t) = \sin 3t + \sin \pi t$ ii. Differentiate between energy and power signal iii. Sketch the odd part of the signal u(t) where u(t) is a unit step function iv. Sketch the signum function sgn t. How is it related to the function obtained in iii above?	[01] [04] [01] [02] [01] [01]
Q1 (b)	(i) Check the Linearity and Time-invariance of the system $y(t)= t^2x(t)$, where y(t) and x(t) are the output and input respectively. (ii) Sketch each of the individual waveform of the signal x(t) given and then sketch the resultant x(t) $x(t) = [u(t) + r(t-1) - 2u(t-3)]\, u(-t+5)$	[05] [05]
Q2 (a)	i. Determine the signal x(n) for the following Discrete Time Fourier Transform $X(e^{jw})=e^{-jw}(1+\cos w)$ ii. Determine the Fourier Transform of coswn u(n) iii. State and explain any two properties of the Fourier Transform excluding the linearity property. **OR** i. The impulse response of an LTI system is h(n) = {-2, -1,3, -2}. Find the response of the system for x(n)= {2,3,4,1}.	[03] [03] [04] [05]

	ii. Consider the causal, discrete-time, linear constant-coefficient difference equation: $y[n] - 0.8y[n-1] =$ ~~u[n]~~. x[n]. a) Determine the transfer function H(z) of the system. b) Is the system stable? Why?	[05]
Q2 (b)	When two systems are in cascade the impulse response is the convolution of the impulse responses i.e $h(n) = h_1(n) * h_2(n)$. Determine the impulse response for the cascade of two LTI systems having impulse responses $h_1(n) = (1/2)^n\, u(n)$ and $h_2(n) = (1/4)^n\, u(n)$. How will you verify your answer? OR Find the poles and zeros of the system function and display them in the complex z-plane. $$H(z) = 1 - 2z^{-1} + 2z^{-2} - z^{-3}$$	[05]
Q3 (a)	Determine Z transform of the following signals, draw the ROC i. $x(n) = \left(\frac{-1}{5}\right)^n u(n) + 5\left(\frac{1}{2}\right)^n u(-n-1)$ ii. $x(n) = n^2\, u(n)$	[05]
Q3 (b)	Determine all possible functions x(n) if i. $X(z) = \dfrac{5z^{-1}}{(1-2z^{-1})\,(3-z^{-1})}$ ii. $X(z) = \dfrac{3z^{-1}+1}{3z^{-1}+1+2z^{-2}}$ **OR** i. Obtain direct form II realization of a system described by following $$y(n) = -\frac{5}{4}y(n-1) + \frac{1}{8}y(n-2) + \frac{1}{16}y(n-3) + x(n) + 5x(n-1) + 6x(n-2)$$ ii. An LTI System is described by the following equation, determine the cascade or parallel realization structure of the system. $$y(n) - \frac{3}{10}y(n-1) - \frac{1}{10}y(n-2) = x(n) + \frac{1}{9}x(n-1)$$	[10] [05] [05]

Q4 (a)	The input x(n) and impulse response h(n) of an LTI system are as given below. Determine the response of the system using linear convolution. x(n) = {1, $\underset{\uparrow}{2}$, 1, 2} and h(n) = {2, 2, $\underset{\uparrow}{-1}$, 1} Validate your answer using the tabular method. OR A continuous time LTI system is represented by the equation $$\frac{d^2y}{dt^2} + 3\frac{dy}{dt} + 2y(t) = 2\,x(t)$$ (i) Determine the transfer function of the system (ii) Determine the impulse response of the system described by the equation.	[10] [10]
Q4 (b)	For an LTI system with unit impulse response $h(t)=e^{-2t}\,u(t)$ determine the output to the input $x(t) = e^{-t}\,u(t)$ using convolution. Verify your result by using either Laplace transform.	[05]
Q5 (a)	**Solve any two.** **i.** State the initial and final value theorem. Determine the initial and final values of x(t) if its Laplace transform is given by : $$X(s) = \frac{0.8}{s^2+0.6s+0.2}$$ ii. Mention the applications of signals in any one of leading technological fields of today. iii. Find the z-transform of the signal x(n)= {2,1,2}. Determine its ROC. Hence or otherwise find the DTFT of x(n). Compute its magnitude at w=0 and w=π/2	[05] [05] [05]
Q5 (b)	i. Express the signal x(n)={1,2,3,4} as a sum of impulse functions. ii. Mention any two examples of causal systems. iii. State an expression to obtain discrete time fourier transform of x(n). Obtain the formula of X(z) from the same.	[02] [01] [02]